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Railroad Abandonment: Optimal Solutions and Policy Outcomes

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I. Introduction

The bankruptcy of the Penn Central along with several small railroads in the same region initially focused attention on the problems of railroad transportation in the Northeast. However, subsequent events, including the severe difficulties facing such major railroads as the Rock Island Line and the Milwaukee Road, have clearly indicated that the rail transportation problem is much more widespread. In fact, a recent study for the U. S. Department of Transportation (August, 1977) argues that about 20 percent of the existing U. S. rail system appears to be uneconomic and that the percentage for the West North Central region is higher than for the Northeast, while the Mountain, Pacific, and West South Central are almost as high. It has been argued that a substantial portion of these uneconomic lines must be abandoned in order to eliminate the continuing losses on such lines and to create a system of financially viable rail carriers. However, shippers and other interested parties have argued that abandoning such lines would substantially increase transportation costs and could severely damage economic conditions in areas affected by loss of rail service.

The purpose of the present study is to analyze the impact of abandonment on shipping costs in comparison with the subsidies required to keep these lines in operation and, based on the results of this analysis, to examine the outcomes of abandonment policy, namely, which lines have been abandoned and on

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which service has continued under subsidy. The study focuses on Ohio because Ohio is an important railroad state in the Northeast where the abandonment issue had to be faced earlier and under more critical conditions than in other regions. As recently as 1975 Ohio had approximately 7,500 miles of railroad track, of which about 4,000 miles was owned by solvent private carriers and somewhat more than 2,300 was designated to be operated by the Consolidated Rail Corporation (Conrail). This left the future of the remaining 1,200 miles of primarily light density lines considerably in doubt. It was anticipated, moreover, that portions of the 6,300 miles of track to be operated by Conrail and the solvent private carriers would soon be considered for additional abandonments. Ohio is also of particular interest because the Ohio Constitution, unlike the constitutions of most other states, prohibits the use of state tax revenues to subsidize private enterprises such as rail carriers or shippers.[1/] This study is limited to grain transportation in 31 counties of central and western Ohio because most of the Ohio rail lines potentially subject to abandonment are located in this area and because grain transportation is the most important activity on most of these light density lines.

The economic viability of light density lines is analyzed in a framework which assumes that several important variables are fixed because their consideration is beyond the scope of this study. The Interstate Commerce Commission (ICC) regulates the rates for all rail carriers, and deregulation could lead to a significantly different rate structure which might affect the viability of some light density lines. The abandonment issue is, however,

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[1/] The Constitution of the State of Ohio (Article VIII, Section 4) prohibits the state from subsidizing private firms. Efforts have been made to change this provision as an amendment was proposed to permit such subsidies, but this amendment was defeated in the general election of November 4, 1975, by almost 2 to 1.

analyzed with the rate structure as currently given. The U. S. Department of Transportation (January, 1977, p. 25) indicated in a recent study that

> The essential ingredients of a line specific viability test are: (1) accurate segment data, and (2) accurate revenue and cost itemization. However, available revenue and costing methodologies are totally inadequate.... For the most part, the railroads themselves have no specific measures of the economic viability of their own line segments, except when branch lines are studied for possible abandonments.

Although the issues of cost allocation among rail lines and revenue division among rail carriers underlie abandonment decisions, they are also taken as given for the present study.[2/] In addition, the pricing of services for alternative transport modes such as truck or barge is taken as given without investigating the possible subsidies that may exist for these modes.[3/]

The second section of this paper describes the two Congressional acts which followed the bankruptcy of the Penn Central and provided the legal and financial framework for the reorganization of the rail system in the Northeast and, in particular, established the categories and procedures to deal with applications for rail line abandonment. The third section presents the model used to estimate the additional costs of grain transportation resulting from the abandonment of 17 light density lines in 31 counties of central and western Ohio. The fourth section discusses the outcome of the policies with respect to the abandonment or subsidy of these light density lines, that is, which lines had been abandoned as of the summer of 1979 and which were continuing to operate under subsidy. The final section summarizes the main results of the study and

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[2/] For examples of some of the difficulties involved in estimating railroad freight costs, see Griliches and Harris.

[3/] For example, the U.S. Department of Transportation (1978, pp. 106-107) estimates that a five axle diesel powered tractor-trailer with a gross weight of more than 60,000 pounds imposes a cost on the highway system of nearly twice the amount paid in federal user charges.

discusses the implications of these results for rail abandonment at the national level and, in particular, the need for further detailed studies of rail abandonment in other regions.

II. Legislative History and Abandonment Procedures

The bankruptcy of the Penn Central in 1970, along with several smaller railroads in the Northeast region, led to considerable debate over the crisis in U. S. rail transportation. One result of this debate was the passage by Congress of the Regional Rail Reorganization Act of 1973 (3 R Act) which contains several provisions for reorganizing the railroads in a 17 state area of the Northeast. In particular, the 3 R Act created the U. S. Railway Association (U.S.R.A.), a non-profit government planning organization, which was given the responsibility of planning a restructuring of the railroads in the area and the authority to guarantee loans for that purpose up to $1.5 billion. The U.S.R.A. issued its "Preliminary System Plan" in February, 1975, and its "Final System Plan" in July, 1975, which outlines the new structure and the legal and financial conditions for reorganization. Other important features of the 3 R Act are: (1) the creation of Conrail, a privately managed for profit organization, to operate the new rail network which was to survive the restructuring of the bankrupt lines; (2) grants of approximately $558 million to the bankrupt railroads to keep them operating during the restructuring; (3) protection from job loss for the railroad employees affected by the reorganization; and (4), most important for the present paper, subsidization (along with the affected states) of light density lines not included in the Final System Plan.[4/]

[4/] Light density lines are defined in the Final System Plan as those with an annual traffic density of less than 5 million gross ton-miles

The Final System Plan became effective on April 1, 1976, after Congress passed the Rail Revitalization and Regulatory Reform Act of 1976 (4 R Act) to provide the necessary funding. Besides funding Conrail, the 4 R Act expands the scope from the initial 17 states to the entire country and provides for additional financial assistance to the railroad industry, including $360 million over a five year period to subsidize the operation of uneconomic light density lines. This subsidy is to be paid partly by non-Federal sources, with the Federal share declining from 100 percent in the first year to 70 percent in the fifth year.[5/] Criteria were also established by which rail lines would be judged as financially viable or potentially excess. Using those criteria, Conrail took over approximately 17,000 miles of rail lines, while approximately 6,000 miles of light density lines were designated as potentially excess and excluded from Conrail. Light density lines designated as potentially excess are to be abandoned unless subsidized, primarily with Federal monies, under the terms of the 4 R Act. To qualify for rail service continuation subsidies, each state must develop a rail plan and designate a state agency (e.g. the Ohio Rail Transportation Authority) to implement the plan.

The 4 R Act amended the Interstate Commerce Act to provide for advance notice of potential abandonments and to facilitate offers of financial assistance to continue service on rail lines that would otherwise be abandoned. Under the amendment, the ICC issued new regulations which require

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[5/] The non-Federal share may be paid by state governments, local governments or other interested parties such as shippers. Under the 4 R Act the Federal share was to decline to 70 percent on April 1, 1979, but the Local Rail Services Assistance Act of 1978 continued the Federal share at 80 percent until June 30, 1980, and extended the expiration of the program until June 30, 1981.

each rail carrier to identify on a system map all the rail lines that it operates. On this map the following five categories of lines must be identified: Category 1, lines which the rail carrier will seek to abandon within three years; Category 2, lines under study by the carrier for possible future abandonment; Category 3, lines for which an abandonment application is pending before the ICC; Category 4, lines which are currently operating under rail service continuation subsidies; and Category 5, all other lines owned or operated by the rail carrier.[6/]

If a rail carrier wishes to abandon a line, it must follow certain procedures set forth by the ICC. An uneconomic rail line will frequently, but not necessarily, first be identified in Category 2 before it shifts to Category 1. Any line that a carrier wishes to abandon must be identified in Cateogry 1 for at least four months before it can move to Category 3 with the filing of the abandonment application. After this period the carrier next files a Notice of Intent which announces the railroad's intention to discontinue service on the line. Within 30 days after the Notice of Intent is posted, the abandonment application must be filed, and interested parties have a maximum of 35 days after this filing to submit comments to the ICC. If no significant protests are received from interested parties, the ICC will issue an initial decision permitting abandonment to become effective 60 days after the application was filed by the carrier.

If significant protests are received from interested parties, the ICC shall complete a formal investigation within one year. After complet-

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[6/] See Table 2 below for the mileage within Ohio in the different categories as of August 1, 1978.

ing the formal investigation, the ICC will either deny the railroad's abandonment application or issue an initial decision permitting abandonment. Interested parties have a maximum of 20 days to appeal an initial decision which gives notice that, unless a purchase or subsidy offer is made, a final authorization permitting abandonment will be granted. If a subsidy offer is made, the abandonment decision will be postponed for up to six months to give the rail carrier and the interested parties time to negotiate a subsidy agreement. If no agreement is signed within six months, the ICC shall issue a final certificate authorizing abandonment. If an agreement involving a subsidy to continue service is reached, the line will then appear in Category 4 on the system map.

III. A Model to Estimate the Costs of Rail Abandonment

The following section estimates the additional transportation costs facing grain shippers in a 31 county area of central and western Ohio as a result of the abandonment of 17 light density lines. Several different analytical methods have been used to study grain transportation in recent years, but the most popular technique has been some type of linear programming model (see, for example, Ladd and Lifferth or Tyrchniewicz and Tosterud). However, linear programming techniques can be computationally too costly to handle the large models which are often encountered in transportation problems. Network analysis, on the other hand, yields the same optimal solution but can handle significantly more variables and constraints at much lower computational cost than linear programming or other optimization techniques.[7/] Consequently, the network technique is used in the present

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[7/] See Bradley for an exposition of the advantages of the network technique. Although few studies have applied this technique to agricultural transportation problems, Fuller, Randolph and Klingman have recently used network analysis to study the location of agricultural processing plants.

study to formulate the grain transportation problem as a constrained network flow which is solved by the Out-of-Kilter Algorithm (see Durbin or Ford and Fulkerson). The objective is to estimate a set of flows through the arcs that minimizes total costs of grain transportation and handling and simultaneously satisfies all demands without violating the capacity limitations of the network.

In the present study a multi-period transhipment model is developed, the solution of which minimizes the total cost of grain transportation and handling from farm origins in a 31 county area of central and western Ohio to final destinations. The major activities in the model are farm storage and drying, elevator storage and drying, elevator receiving and load-out, and transportation by truck, rail and barge. Rail shipping activities are subdivided into the single car, multi-car and unit train options which elevators have available in Ohio. Farm supplies and final demands for grain are assumed to be fixed and not responsive to changes in costs of transportation and handling.[8/] To coincide with grain harvesting and shipping patterns, the network is divided into three time periods: (1) June through August, the wheat harvest and marketing period; (2) September through December, the corn and soybean harvest and the marketing period prior to the closing of the Great Lakes for shipping; and (3) January through May, the balance of the marketing year. Storage activities and storage costs

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[8/] Corn, soybean and wheat production for each county was obtained from Ohio Agricultural Statistics, 1975. Assuming that corn, but not wheat or soybeans, was fed to livestock in the study area in 1975, the transportable surplus of grain for each county was defined as soybean and wheat production plus corn production adjusted for feed use. Feed use in each county was estimated from the numbers of each of six classes of livestock multiplied by corn consumption rates for each class.

connect one time period to the next, so that grain can be transferred over time as well as space.[9/]

To analyze the impact of rail abandonment, county grain elevators have been classified according to the mode of transportation used: (1) elevators using truck transport only; (2) elevators using truck and rail service and not exposed to rail abandonment; and (3) elevators using truck and rail service and located on a light density line which may be abandoned. A farm storage activity is also included to assess possible changes in on-farm storage due to rail abandonment.[10/] In addition, the network permits intra-county transfer of grain among elevators, so that elevators losing rail service can tranship grain to other nearby elevators. From county elevators grain may be shipped by truck or rail either directly to final destinations or to inland or river terminals which then ship to final destinations. These final destinations include grain processors, Great Lakes terminals, East Coast terminals, Gulf Coast terminals, and domestic destinations within Ohio and the rest of the U. S..[11/]

As indicated in the introduction, rates for rail shipping activities are set by the ICC, and these rates depend on a multiplicity of factors including the commodity shipped, the mileage covered and the size of the shipment. These rates are, as indicated, a crucial consideration in abandonment, as well as an integral part of the calculation of the change in

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[9/] Operating costs for grain handling and storage in commercial elevators were obtained from the U.S.D.A., Economic Research Service.

[10/] County farm storage capacity and cost data were estimated from a study by Smith and Baldwin for a 20,000 bushel bin dryer system.

[11/] See Kane for a more detailed discussion of the model.

grain transportation costs due to abandonment. One particularly important aspect is the different rate structures facing different grain elevators depending on the size of shipments: some elevators have unit train rates as well as multi-car rates for shipments of three to ten cars, while others have only single car or multi-car rates up to ten cars.[12/] Unlike rail rates, truck rates for unprocessed agricultural products are unregulated, so that these costs in the model are calculated on the basis of the commercial rate structure and vary by mileage increments (see Kane, pp. 68-69).

To obtain the necessary data on grain market structure and flows for the crop year 1975-76, interviews with a stratified random sample of 58 grain elevators in 31 counties of central and western Ohio were carried out during the summer of 1976. Information was collected on elevator size, use of different transport modes, location on rail lines, and grain flows over space and time. As shown in Table 1, there were 17 rail lines with a total of 344.7 miles of track subject to abandonment in this 31 county area. These 17 rail lines varied in length from 3 to 50 miles and had 18 elevators along their routes.

Rail line abandonment is simulated by setting the upper limit on rail load-out activities equal to zero for the 18 elevators which are located on rail lines subject to abandonment. The cost-minimizing solution to the model with rail shipments restricted to zero from these elevators can then be compared to the cost-minimizing base solution in which no such restrictions are imposed. Total transportation costs in the base solution are $71.3 million for the system to handle more than 297 million

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[12/] Railroad rates for single car, three, five and ten multi-car, and 60 and 100 car unit trains were obtained from Free *et al*.

Table 1: Railroad Lines in Central and Western Ohio Abandoned, Sold or Subsidized as of July, 1979

Name of Line	USRA Line No.	Total Miles	Abandoned	Sold	Subsidized
St. Marys-Bellefontaine	502/3/4/	38.8	37.1	0	1.7
Richwood-Urbana	1264	32.7	29.7	3.0	0
Bremen-Washington C.H.	496/496a/497	67.8	65.2	2.6	0
Troy-Arcanum	551	23.5	18.9	4.6	0
Howard-Holmesville	478	35.3	35.3	0	0
Yellow Springs-Springfield	536/37	11.8	0	0	11.8
Hempstead-Lytle	527/28	9.0	0	0	9.0
Spring Valley-Roxanna	516	5.6	0	0	5.6
Marion-Richwood	1263	14.3	0	0	14.3
Lebanon-Hageman	525	5.6	0	0	5.6
Lima-Wren	1261	50.0	0	0	50.0
Van Wert-Ohio City	553	5	5	0	0
Ohio City-Rockford	534	7.2	0	0	7.2
Rockford-Celina	534	10.5	10.5	0	0
Celina-St. Henry	534a	9.9	0	0	9.9
St. Henry-Ansonia	535	14.2	14.2	0	0
Valley Junction-Harrison	571a	3.5	0	0	3.5
Total		344.7	215.9	10.2	118.6

bushels of grain. The most important result in the abandonment solution is that transportation costs for the system increase by only $253,197 (0.35 percent). This amount is far less than the nearly $4 million in subsidies which the Ohio Department of Transportation Branch Line Plan (pp. 43-240) estimated would have been needed in 1976 to upgrade and continue service on the 17 light density lines in the study area which are subject to abandonment. In the abandonment solution the total volume of grain shipped by rail from all elevators continues to be almost twice as great as the volume shipped by truck, just as in the base solution. Moreover, in the abandonment solution there are no intra-county shipments of grain from elevators losing rail service to those retaining service, again replicating the results of the base solution.

In spite of the absence of significant changes in the aggregate in moving from the base solution to the abandonment solution, there are some substantial differences between the two solutions, especially for the different categories of grain elevators. In the base solution the elevators potentially losing rail service ship predominantly by rail, and these shipments are, of course, eliminated in the abandonment solution.[13/] However, a portion of this lost activity is regained in shifts away from elevators which have only truck service available. In the abandonment solution the elevators losing rail service compete more strongly with the truck-only elevators for the intrastate grain shipments which move mainly by truck and are eliminated from the

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[13/] In the interviews carried out in 1979, many of the elevators located on lines subject to abandonment stated that they made little use of rail service, even when the base solution indicated that rail was the least cost alternative. Apparently some grain elevators have found rail service more costly than indicated because of its poor quality, which suggests that the increment in shipping costs in moving from the base solution to the abandonment solution may be overstated.

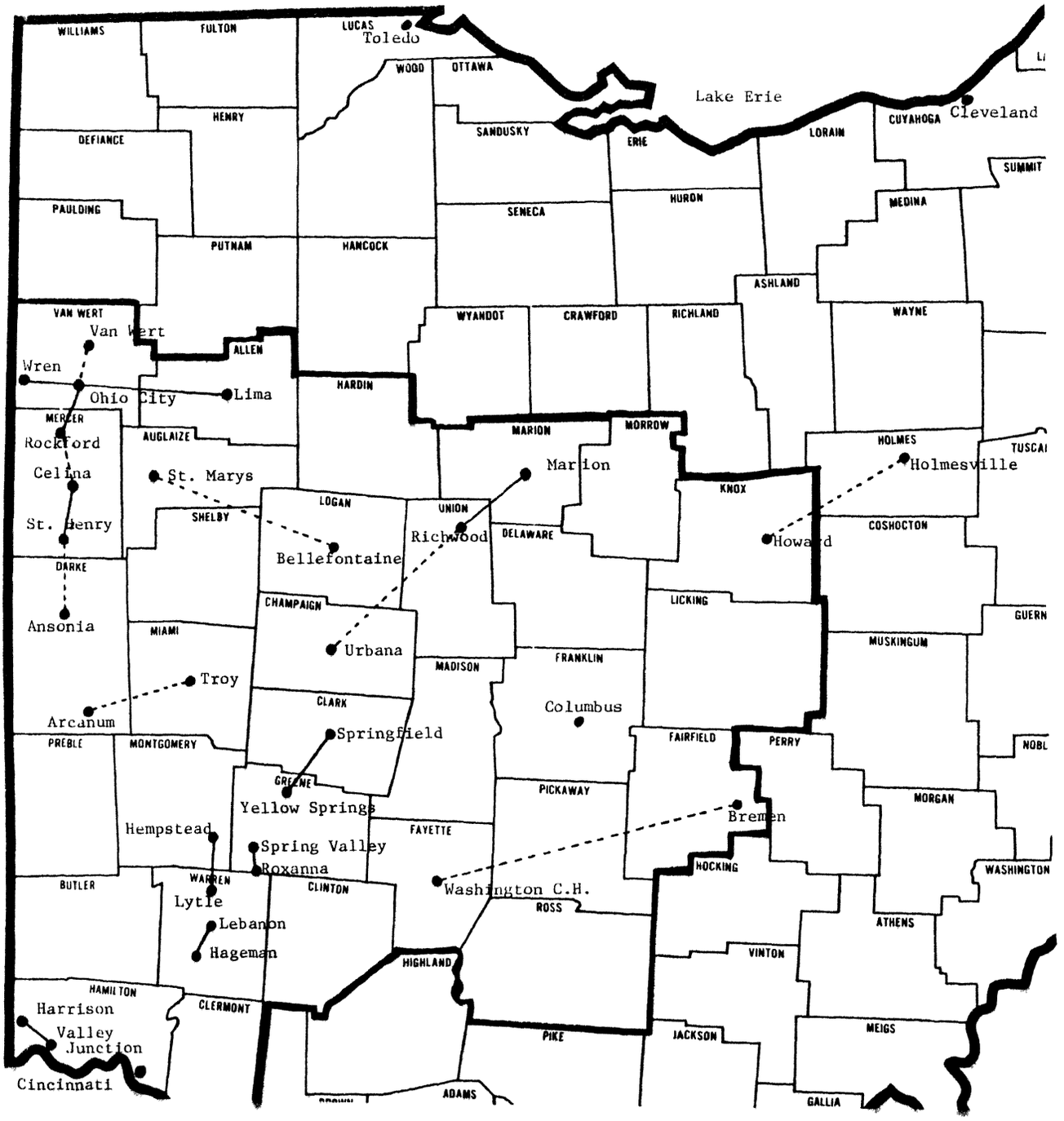
inter-state grain market which is almost exclusively served by rail. Grain elevators with rail service not subject to abandonment, especially those with multi-car capabilities, experience a significant increase in shipping activity under the abandonment solution. There are also related shifts in storage away from truck-only elevators and elevators losing rail service under abandonment to elevators with continuing rail service and especially to on-farm storage.

It should be noted that the model does not have an investment activity and hence does not allow for increases in capacity which might well be significant for elevators experiencing an increase in shipping and storage. To the extent that capacity constraints are important, such investments might be expected to reduce the increase in transportation costs which occur under the abandonment solution. On the other hand, elevators losing business might cease to operate if they cannot cover costs and earn an adequate profit in the long run. The model also does not include transportation activities by farmers, and these might be expected to increase under the abandonment solution as some farmers haul their grain longer distances to elevators with continuing rail service. Such a change might imply greater maintenance expenditures on rural roads not designed to carry an increased volume of heavy shipments of grain.

IV. Subsequent Survey of Lines Subject to Abandonment

A survey of the individual light density lines potentially subject to abandonment which was carried out during the summer of 1979 revealed that not all of these lines had been abandoned (see Table 1 and Figure 1). The outcome of subsidy policies some three years after the initial analysis of the costs and benefits of abandonment shows that 8 of the 17 lines covering 63 percent of the mileage in question have been abandoned, while 9 of the 17

Figure 1: Abandoned and Subsidized Rail Lines in Central and Western Ohio as of July, 1979



Key

Abandoned Lines ----------

Subsidized Lines ——————

lines covering 34 percent of the mileage are operating under rail service continuation subsidies, and the remaining 3 percent of the mileage has been sold. Of the lines operating under subsidy, most are operated by Conrail but three are operated by short line railroads.[14/]

The abandoned lines represent those lines excluded from Conrail which were available for subsidy under the Final System Plan, but for which no operating subsidy agreement was reached between the shippers and the carrier. The first four lines listed in Table 1 were abandoned, except for small segments of each line, early in the subsidy program because shippers showed only limited interest in subsidizing the entire length of these relatively long lines.[15/] On two of the lines grain shippers showed no interest in participating in a subsidy agreement, but on one of these lines a grain shipper stated that the loss of rail service and the resulting increase in transportation costs with trucking made him less competitive so that he lost volume and needed a wider margin to cover the added cost of operation. On another abandoned line a grain shipper continues to use rail service by trucking to a nearby solvent carrier, which adds to his cost but is nonetheless cheaper than shipping entirely by truck. The fifth line in Table 1, the Howard-Holmesville line, operated under a subsidy agreement until the line was recently abandoned. Grain shippers on this line stated that they participated in a subsidy agreement for about two years, but during the second year firms began to drop out of the agreement so that it became too expensive for the remaining firms to pay the growing share of the subsidy.

[14/] A short line railroad is a separate transportation company owning and coordinating freight service over a limited expanse of track and connecting with one or more larger railroad systems.

[15/] Three small segments were sold to solvent private carriers or to shippers, and the smallest segment was subsidized by two industrial shippers and is now considered to be financially viable.

Shippers on the abandoned lines frequently complained that the quality of rail service had been deteriorating for some time prior to abandonment, and this greatly lessened their interest in participating in any subsidy agreement. The railroads had incurred large operating deficits on most of these lines for many years prior to abandonment. As common carriers, the railroads are obligated to continue all authorized service until complete withdrawal is permitted by the relevant agency, the ICC in the case of railroads. Since annual maintenance costs for light density lines typically range from $2,500 to over $3,000 per mile, railroads were able to reduce substantially their expenditures, and hence reduce their deficits, by deferring maintenance on these lines. Shippers in central and western Ohio, already frustrated by rail car shortages, cars in poor condition or lost in shipment, and infrequent service were also affected by the undependable service resulting from deferred maintenance and thus began to seek alternative modes of transportation, usually trucking. Although published rates may make rail service appear cheaper than trucking, the poor quality of service on some lines before abandonment has often made overall costs lower for transportation by truck.

The next five rail lines listed in Table 1 are operated by Conrail under rail service continuation subsidies.[16/] The Yellow Springs-Springfield, the Hempstead-Lytle and the Spring Valley-Roxanna lines all are subsidized under agreements involving only industrial shippers. The grain shippers located on these lines complained about the poor quality of rail service and stated that they therefore preferred to ship by truck. However, it should be pointed

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16/ It is interesting to note that the subsidized rail lines listed in Table 1 are quite short relative to the abandoned lines. This is consistent with Due's analysis of the factors affecting the survival of light density lines.

out that failure to enter a subsidy agreement would not prevent them from using the subsidized rail service. The other two of these five lines are operated under subsidy agreements which include both grain shippers and industrial shippers. One grain shipper on the Marion-Richwood line pays a portion of the rail subsidy even though he currently ships only by truck because he wishes to retain the option of rail service. Other grain shippers argued that this line could be made viable if rail service were improved and especially if more covered hopper cars were available so that traffic on the line could be increased. Grain shippers on the Lebanon-Hageman line expressed concern about the future viability of this line because trucking would be cheaper than shipping by rail if the amount of the subsidy which they have to pay increases significantly in the future.

Two aspects of rail service continuation subsidies mentioned earlier should be emphasized at this point: (1) the non-Federal share of the subsidy is currently 20 percent but is scheduled to increase to 30 percent in mid 1980; and (2) the amount of the subsidy is based on estimates of revenues and costs which are subject to considerable controversy. In order to compute the deficit to be covered by the subsidy, a line segment is allocated the revenues accruing to Conrail from all freight originated or terminated on that line and is charged all the avoidable costs of operation on that line segment plus all the avoidable off-branch costs of moving the freight. These cost estimates are based on system-wide averages for freight shipments which may not be an accurate measure of the costs of moving freight over a particular portion of the system

Three short line railroads which operate under rail service continuation subsidies were created from the last seven lines listed in Table 1. The Spencerville and Elgin, which runs from Lima to Wren with a spur from Ohio City to Rockford, is owned by four grain and fertilizer firms which felt

threatened by the loss of rail service and hence integrated into the transportation business.[17/] These firms share equally the cost of the non-Federal portion of the subsidy, but some non-subsidy-paying shippers also use this rail service. The Western Ohio railroad which operates the Celina-St. Henry line is owned by an individual who is not a shipper and who may derive significant non-pecuniary benefits from operating a railroad under government subsidy.[18/] Of the seven shippers paying the non-Federal portion of the subsidy on this line, none is an important grain shipper. The Valley Junction-Harrison line forms the Ohio portion of the Indiana and Ohio short line railroad. This portion has been profitable because of the revenues generated by two large lumber and building supply firms and one grain elevator. However, the Indiana portion requires large subsidies, with the non-Federal share being paid by the state of Indiana rather than by private shippers.

The determination of revenues and costs in order to arrive at the amount of the subsidy for a short line railroad is significantly different from that for the light density lines operated by Conrail under rail service continuation subsidies. The revenue earned by a short line is negotiated with the connecting carrier as a share of the total revenue accruing to the connecting carrier for moving freight originating or terminating on the short line. This share is based in general on the length of haul on the short line and on the connecting carrier but may differ according to the specific agreement which the short line negotiates with the connecting carrier. The short line railroad is responsible for all operating and maintenance costs on the lines which

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[17/] The Van Wert-Ohio City line was abandoned when this short line was formed.

[18/] The Rockford-Celina and St. Henry-Ansonia lines were abandoned when this short line was formed.

it leases, but not for off-branch costs. Both for short line railroads and for light density lines operated by Conrail, lease costs are a major portion of total costs.[19/] The lease cost is based on the net liquidation value of the line, estimated from Rail Services Planning Office standards, multiplied by the interest rate on short-term U.S. Treasury notes. Due to increasing interest rates and the increasing value of scrap steel and land, lease costs have increased rapidly from an average of $2,475 per mile in 1977-78 to an estimated $6,931 in 1979-80. Shippers and the Ohio Rail Transportation Authority have often complained about this rapid increase in lease costs, and in some cases a reduction has been negotiated.

V. Conclusions

The main conclusion of the present study is that the abandonment of 17 light density rail lines in central and western Ohio would have very little impact on grain transportation costs. When the abandonment solution is compared to the base solution of the network model, grain transportation costs increase by only $253,197, which is less than one-half of 1 percent of the total cost of moving grain produced in the 31 county area under study. This contrasts with the nearly $4 million in subsidies which the Ohio Department of Transportation Branch Line Plan estimated would have been needed in 1976 to upgrade and continue service on these 17 light density lines. To the extent that individual grain shippers are required to pay the costs of maintaining service on light density lines, it would be expected that most of the 17 light density lines would be abandoned. In spite of the very small increase in

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[19/] The short line railroads lease from the bankrupt Penn Central or Erie Lackawanna, while the lease costs for the light density lines operated by Conrail are imputed for the purpose of calculating the amount of the subsidy.

aggregate grain transportation costs due to abandonment, the network model reveals a significant impact on specific grain elevators and shippers, and some of these individuals might be willing to pay substantial amounts to maintain rail service.

A survey of the 17 light density lines subject to abandonment carried out in the summer of 1979 revealed that about half of the lines covering more than 60 percent of the mileage in question had been abandoned. A key factor in the abandonment of many light density lines has been the deterioration of service due to deferred maintenance - a policy which allowed the railroads to reduce their losses on the lines on which they had been required to continue service. Some grain shippers stated that due to the poor quality of rail service they had already switched to trucking before abandonment, even though the published rates used in the network model indicated that rail service should be lower cost. Another important factor in abandonment appears to be the length of the line. Shorter lines, and small segments of some longer lines, have tended to remain in service, while most of the longer lines have been abandoned. Finally, the survey encountered few, if any, examples of "captive" shippers, as few firms stated that they would incur a substantial increase in transportation costs due to abandonment. In addition, almost all lines operating under subsidy were subsidized by more than two shippers, and these groups generally indicated that they were unwilling to pay appreciably greater subsidies because of the availability of alternative modes of transportation.

The Ohio Constitution requires that shippers, rather than the state, pay the non-Federal share of the rail service continuation subsidies, and this may have been an important factor contributing to the abandonment of non-economic rail lines in Ohio. Table 2 compares the rail mileage in Ohio in the

Table 2: Rail Mileage by ICC Categories in State Rail Plans for Ohio and Indiana as of August, 1978

ICC Categories	Ohio	Indiana
Total Rail Mileage	6,700	6,405
Category I: anticipated to be abandoned in three years.	138.8	209.5
Category II: under study for potential abandonment.	154	270.9
Category III: pending abandonment.	185.8	133.5
Category IV. operating under subsidy.	160	382.0

different ICC categories with the mileage in Indiana, a state where tax monies can be used to pay the non-Federal share of the subsidy. Total mileage for the two states is nearly equal, but Indiana has more than twice as many miles operating under subsidy as Ohio. Moreover, Ohio has more miles pending abandonment, while Indiana has more miles in Categories I and II which seem more likely to end up operating under subsidy in the case of Indiana. The question of who pays the non-Federal share of rail service continuation subsidies and the impact on abandonment decisions is clearly an important issue for further study in other states.

Extrapolating the results for Ohio to the national level requires not only studies of subsidy policies such as those just suggested, but also studies for other regions and other products of additional transportation costs resulting from abandonment. Ladd and Lifferth have examined a multi-county area in Iowa and Tyrchniewicz and Tosterud a part of Southwestern Manitoba, and in both cases the added costs due to abandonment were found to be quite small. However, these studies are limited to grain transportation and to areas not markedly dissimilar to central and western Ohio. Moreover, as mentioned in the introduction and elsewhere in the present paper, railroad abandonment is significantly influenced by the procedures used to allocate costs and to divide revenues, by the setting of rates for railroads, and by the implicit subsidies which are alleged to exist for alternative modes of transportation. Final conclusions about the advisability of abandonment cannot be reached without taking these considerations into account.

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